PROC. ENTOMOL. SOC. WASH.
108(1), 2006, pp. 139–144

A WILLOW SAWFLY, *NEMATUS SALICIS* (LINNAEUS) (HYMENOPTERA: TENTHREDINIDAE), A NEW RECORD AND NEW PEST OF *SALIX* SPP. IN TURKEY

Önder Çalmasur and Hikmet Özbek

Atatürk University, Agricultural Faculty, Department of Plant Protection, 25240 Erzurum, Turkey (e-mail: calmasur@atauni.edu.tr; hozbek@atauni.edu.tr)

Abstract.—A willow sawfly, *Nematus salicis* (Linnaeus, 1758) (Hymenoptera: Tenthredinidae), is a new record for the Turkish fauna and a new pest of willow (*Salix* spp.) in Turkey. Its developmental stages, biology, damage, and parasitoids were studied in Erzurum during 2002 and 2003. Adults appear during the last three weeks of August, and females insert eggs in groups under the cuticle of the lower surface of willow leaves starting at the leaf apex. Larvae are leaf-edge feeders and consume the entire leaf leaving only the midrib. *Nematus salicis* is univoltine and overwinters as prepupae in cocoons in the soil. One larval parasitoid was reared, *Hyperbatus segmentator* (Holmgren) (Hymenoptera: Ichneumonidae), which is new record for Turkey. One species of egg parasitoid, *Tetrastichus* sp. (Hymenoptera: Eulophidae) also was reared. The percentage of larval parasitism is low, but egg parasitism averages 32.8%.

Key Words: *Nematus salicis,* Tenthredinidae, Hymenoptera, willow pest, *Salix*

Willow (*Salix* spp., Salicaceae) species are grown predominantly along rivers and streams, especially in the eastern and central regions of Turkey. Most species are valuable and popular because of their rapid growth and have been the trees chosen for plantations where a quick return on the investment was desired by villagers. They have been used as firewood and timber, and, to a lesser extent, as conservation and ornamental plantings. *Salix* species are also important for erosion control in the country.

Sawflies are one of the most common and diverse groups of insects found on willows (Benson 1950, Kontuniemi 1960). *Nematus* Panzer is the one of the largest genera of Tenthredinidae associated with willows. Of the willow sawflies, many species induce leaf and stem galls and some make leaf rolls, but most species are free-feeding and important defoliators or skeletonizers (Gauld and Bolton 1988, Fritz et al.1986, Roininen 1991).

Larvae of *Nematus salicis* (Linnaeus) are free feeding and are important willow pests. Although the species is widespread in northern and central Europe and Caucasia (Lacourt 1999), this is the first record of the species from Turkey.

There have been very few studies of the tenthredinid pests of willow in Turkey. *Croesus septentrionalis* (Linnaeus) and *Trichiocampus viminalis* (Fallén) were recognized for the first time as willow and poplar pests in Turkey by Acatay (1943) and Erdem (1962), respectively. Bas (1973) added some data on the damage and biology of these species. Recently, Çalmasur and Özbek (2004a, b) recorded additional tenthredinid species feeding on willow leaves, including the larvae of *Rhogogaster chlorosoma* Benson, *Allantus togatus* (Panzer),

Table 1. Rain, temperature, and humidity in 2002 and 2003 in Erzurum (Meteorology District Directorship).

	Total Rain/mm		Average Temperature (C°)		Average Humidity (%)	
Months	2002	2003	2002	2003	2002	2003
May	73.1	29.9	9.8	11.6	55.8	52.0
June	74.0	45.7	14.3	14.5	57.0	50.6
July	39.1	18.5	18.3	18.9	53.0	49.3
August	54.6	5.1	16.6	20.0	53.6	42.7
September	18.1	19.3	13.6	13.8	52.9	46.3

and *Tenthredo livida* Linnaeus. Çanakcioglu (1993) listed *Salix caprea* as the host plant of *Eriocampa ovata* (Linnaeus).

The purpose of this study is to record the habits and biology of this new pest in the ecological conditions of Erzurum, Turkey.

Material and Methods

This study was conducted in 2002 and 2003 on the campus of Atatürk University in Erzurum, which is located near the base of Palandöken Mountain (over 3,000 m) in eastern Turkey (39°54′005″N and 41°41′184″E, at an altitude of 1,850–1,900 m). Erzurum has cold and snowy winters, rainy springs, and dry summers, with an average temperature of 5.3°C and relative humidity of 64.2% in 1950–2002. The average temperature was 5.1°C in 2002 and 2003. The average temperature of May, June, July, August, and September in 2002 and 2003 are given in Table 1.

Over 30 species of *Salix* occur in Turkey, but only three species are present as ornamental plants on the Atatürk University campus, *Salix babylonica* L., *S. nigricans* Smith, and *S. grandifolia* Seringe. *Salix babylonica* is the most abundant.

Study of *Nematus salicis* began after damage by sawfly larvae were observed on the leaves of *Salix* on the campus in 2001. Adults were reared from these larvae and identified as *Nematus salicis*. Starting in the early summers of 2002 and 2003, willow trees on the campus were checked at several-day intervals, and the biology and damage of *N. salicis* were recorded. Additionally, in order to obtain parasitoids, larvae and eggs were collected randomly from the willows at 3 or 4 day intervals. The larva were reared in cages (30 × 30 × 50 cm) and provided with shoots of willows inserted in glass containers with water. Larvae were transferred to the leaves. Egg masses with leaves were placed in 90 mm Petri dishes in the laboratory and emerging parasitoids were collected with an aspirator. Twenty larvae, cocoons, and adults were measured for body length and head capsule dimensions.

Results

Description.—*Adult* (Fig. 2d): General body color yellow, only compound eyes, vertex, ocellar area, mesonotum, and sheath black. Head from above transverse, broader than long in female with black areas on vertex narrower than those of the male. Antenna dark brown on dorsal surface, light brown on ventral surface; 9-segmented, with 3rd antennal segment approximately equal to longest ocular diameter; antenna almost equal to body length in male, slightly longer than half body length in female. Wings uniformly lightly infuscated, costa and stigma black, other veins brownish; body length 6.0–11.5 mm.

Egg (Fig. 2a): Bean shaped, dirty white; dimensions 0.6–0.7 mm and 1.35–1.56 mm.

Larva (Fig. 2b): Head black, thorax and last abdominal segments yellow, first 8 abdominal segments greenish blue, each body segment marked with 5 black spots which form stripes along the body. Thoracic legs blackish blue, prolegs translucent, present on abdominal segment 2–7 and 10. Late instar larva 2.0–3.3 cm long (Fig. 2b). Larval dimensions (average lengths): 1st instar: 0.4

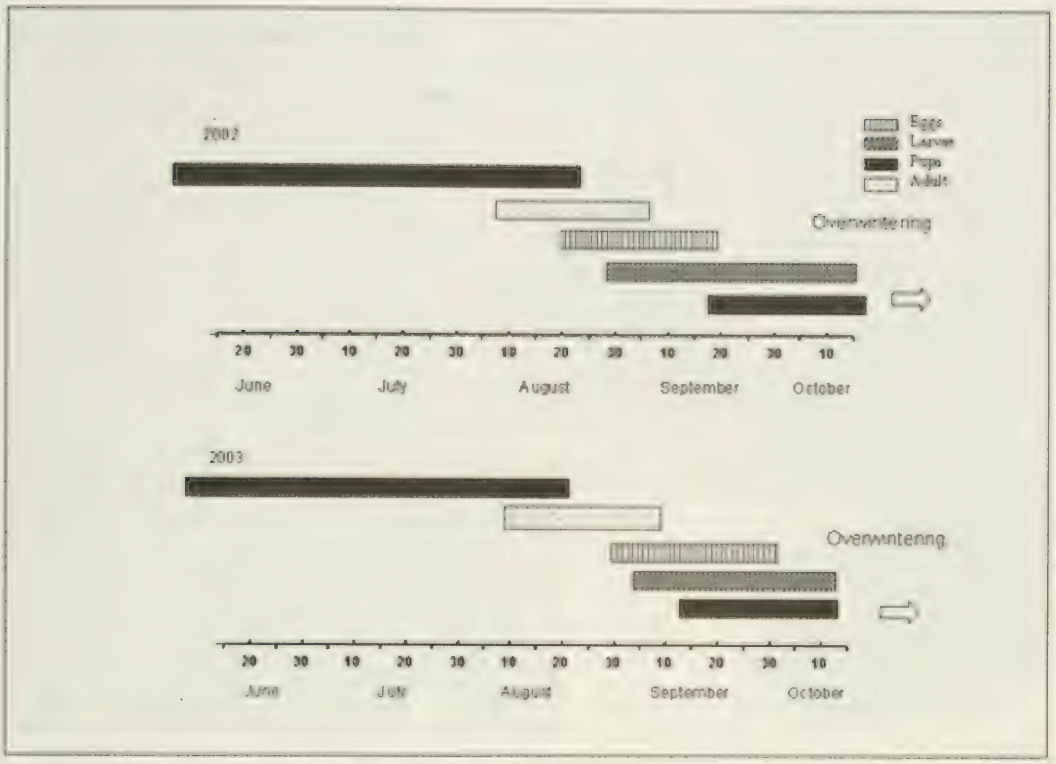

Fig. 1. Duration of biological stages of *Nematus salicis* in Erzurum in 2002 (top) and 2003 (bottom).

cm, 2nd instar: 1.1 cm, 3rd instar: 1.9 cm, 4th instar: 2.5 cm. Head capsule length and width: (0.75–0.65 mm), (1.48–1.38 mm), (2.02–1.97 mm), (2.7–2.45 mm) first, second, third, and fourth instars respectively.

Biology (Fig. 1).—Adults first emerged on August 9 in 2002 and August 11 in 2003. The emergence period lasted about 2 weeks. Females started to oviposit on August 14 and August 18 in 2002 and 2003, respectively. Eggs were inserted in groups under the cuticle of the lower leaf surface, starting at the tips of the leaves (Fig. 2a). Groups of eggs reached from the tip to the middle of the leaves when females deposited the highest numbers of eggs. Numbers of eggs were 8–64 per group (mean = 44, SE = ± 4.3, n = 20 groups). Oviposition lasted until mid-September. Eclosion first occurred on August 19 and August 26 in 2002 and 2003, respectively, and lasted about 10 days. Young larvae fed on the parenchyma tissue for a short period, then continued feeding on the edges of the leaves, usually consuming the entire leaf leaving only the midrib. The larvae pass through four instars. Mature larvae fell to the ground under the trees on which they developed and burrowed into the soil for a distance of 2–10 cm. Here they constructed a brown cylindrical cocoon with soil particles fastened on its surface, 4.0–6.3 cm long and 1.6–2.7cm wide (Fig. 2c). Overwintering was as a prepupa in a cocoon. In both years, larvae entered soil the first week of October. However, we observed low numbers of larvae feeding on the leaves until October 20 in 2003. There is only one generation a year under the ecological conditions at Erzurum during the two years observed.

An epidemic of *N. salicis* on willow occurred in the summer of 2002 on the university campus, and the larval population

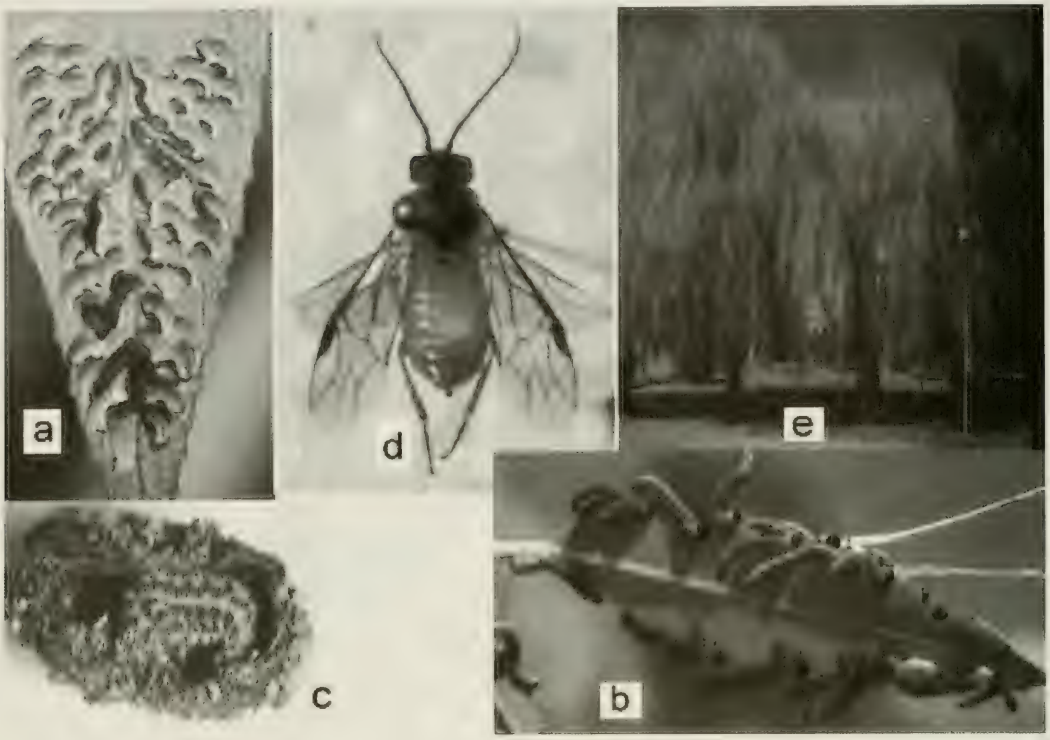

Fig. 2. Damage and biological stages of *Nematus salicis*. a, Egg. b, Larva and damage. c, Cocoon and prepupa. d, Adult. e, Damage. f, *Hyperbatus segmentator* ovipositing in the larva of *N. salicis*.

was much higher than in 2003. Larvae consumed all leaves and defoliated the trees of *Salix babylonica* (Fig. 2e). Because of their high density and lack of preferred food, larvae left the trees after defoliation to find a new food sources. The ground was almost covered with larvae. We counted more than 100 larvae searching for food plants in $1m^2$. We observed that *N. salicis* preferred *S. babylonica* as food plant rather than *S. nigricans* and *S. grandifolia*. However, since most of the *S. babylonica* trees on the campus were defoliated (Fig. 2e) there was serious damage also on other *Salix* species. In spite of an outbreak of *N. salicis* on the campus in 2002, there was negligible larval feeding on the leaves of *Populus tremula* Linnaeus and *P. nigra* Linnaeus although we found some egg masses on the leaves of both poplar species.

In the laboratory, one larval parasitoid, *Hyperbatus segmentator* Holmgren, 1857 (Hymenoptera: Ichneumonidae: Ctenopelmatinae) (Fig. 2f) and one egg parasitoid, *Tetrastichus* (Hymenoptera: Eulophidae) were reared. The percentage of larval parasitism was low, but egg parasitism averaged 32.8% (SE = 2.4, n = 19). *Hyperbatus segmentator* is also a new record for the Turkish fauna.

Discussion

The occurrence of *Nematus salicis* in Turkey is not unexpected since it is known form Europe and Caucasus. According to the classification of the Turkish fauna recently proposed by Vigna-Taglianti et al. (1999), we place *N. salicis* in the European chorotype, which includes species that occur in Europe, Caucasus, and Turkey.

Our observations showed that *N. salicis* is an important pest of *Salix* species, particularly *Salix babylonica* in Erzurum Province. The epidemic of *N. salicis* on willows

in the summer of 2002 on the university campus could be related to more precipitation in 2002 than 2003 (Table 1.).

Our study compares favorably with studies by Martinek (1958) on *Nematus salicis* from the former Czechoslovakia and by Lacroix (1928) from France. Martinek (1958) studied populations on *Salix alba* L. and *S. fragilis* L. and Lacroix (1928) on *Salix* spp. In our studies, *Salix babylonica* was the preferred host species. Also, we found only one generation a year in the ecological conditions of Erzurum, whereas both Martinek (1958) and Lacroix (1928) recorded two generations a year, and a possible third was observed in France (Lacroix 1928). Erzurum is at a much higher elevation with harsher winters and a shorter growing season than the study sites of Martinek (1958) and Lacroix (1928); thus, a single generation a year could be expected in Erzurum where the leaves of the host plant only start to appear in May.

Martinek (1958) recorded six larval instars in his study and Lacroix (1928) recorded four larval instars. Our studies agree with Lacroix (1928).

Martinek (1958) obtained the same ichneumonid parasitoid, *Mesoleius* (= *Hyperbatus*) *segmentator,* as we reared from the larva of this sawfly in addition to other parasitoids. Lacroix (1928) detected *Mesoleius opticus* (Gravenhorst) and *Ptychomyia selecta* Meigen (Diptera) as larval parasitoids. Lacroix (1928) also reared an undetermined Diptera from the egg of *N. salicis.* We obtained a species of *Tetrastichus* as an egg parasitoid, and because of its high percentage rate, it has potential as a biocontrol agent in the control of this willow pest.

It would be worthwhile if further studies on *Nematus salicis* could be conducted in Turkey, particularly in the central and western parts of the country. The distribution range of this important species in Turkey needs to be determined.

Acknowledgments

We are grateful to D. R. Smith, Systematic Entomology Laboratory, U.S. Department of Agriculture, Washington, DC, for determination of the sawfly and making comments on the first version of manuscript. We also thank to Dimitriy R. Kasparyan, Zoological Institute, Russian Academy of Sciences, St. Petersburg, Russia, for identification of the ichneumonid. We are grateful to M. Doganlar, M. Kemal University, Hatay, for determination of the egg parasitoid.

Literature Cited

Acatay, A. 1943. Forest Pests and their Control in Istanbul. No. 142, Ankara, 163 pp. (in Turkish)

Bas, R. 1973. Research on Hymenopterous pests of Forest Trees in Turkey. Forest Ministry Forest General Directorship, 169 pp. (in Turkish).

Benson, R. B. 1950. An introduction to the natural history of British sawflies. Transaction for the Society of British Entomology 10:45–142.

Çalmasur Ö. and H. Özbek, 2004a. A contribution to the knowledge of the Tenthredinidae (Symphyta, Hymenoptera) Fauna of Turkey Part I: The Subfamily Tenthredininae. Turkish Journal of. Zoology 28: 37–54.

Çalmasur Ö. and H. Özbek, 2004b. A contribution to the knowledge of the Tenthredinidae (Symphyta, Hymenoptera) Fauna of Turkey Part II: The Subfamilies Blennocampinae, Dolerinae, Nematinae and Selandriinae. Turkish Journal of Zoology 28: 55–71.

Çanakcioglu, H. 1993. Forest Entomology. Istanbul University Publication No. 3623, Istanbul, 458 pp. (in Turkish).

Erdem, R. 1962. A new *Populus* pest, *Trichiocampus* (*Cladius*) *viminalis* (Fall.) Journal of Forest Faculty XII (2): 1–5 (in Turkish).

Fritz, R. S., C. F. Sacchi, and P. W. Price. 1986. Competition versus host plant phenotype in species composition: Willow sawflies. Ecology 67: 1608–1618.

Gauld, I. and B. Bolton. 1988. The Hymenoptera. Oxford University Press, Oxford, 332 pp.

Kontuniemi, T. 1960. Soumen sahapistiaistoukkien ravintokasvit. Animalia Fennica 9:1–104.

Lacourt, J. 1999. Répertoire des Tenthredinidae ouestpalearctiques (Hymenoptera, Symphyta). Memories de la Société Entomologique de France, No. 3, 432 pp.

Lacroix, J.-L. 1928. Quelques observations sur une mouche à scie nuisible aux saules *Pteronidae salicis* L. (Hyménoptère-Tenthrédinide). Revue de Zoologie Agricole et Appliquée 28: 58–66.

Martinek, V. 1958. Přispěvek k Poznäni bionomie a populačni bynamiky pilatky *Pteronidea salicis* L. (Hym., Tenthredinidae). Zoologicke Listy 7: 1–20.

Roininen, H. 1991. The ecology and evolution of host plant relationships among willow-feeding sawflies. University Joensuu Publications Science 23: 1–21.

Vigna-Taglianti, A., P. A. Audisio, M. Biondi, M. A. Bologna, G. M. Cappaneto, A. De Biase, S. Fattorini, E. Piatella, R. Sindaco, A. Venchi, and M. Zaporoli. 1999. A proposal for a chorotype classification of the Near East fauna, in the framework of the western Palearctic region. Biogeographia 20 (1): 31–59.